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# Digital Transformation and Smart Education in China: Current Status and Challenges

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## Abstract

With China's significant advancements in integrating high technologies such as artificial intelligence, the Internet of Things, virtual reality, and augmented reality into educational systems in recent years, smart teaching in China has enhanced learning experiences and created more interactive and personalized environments. This study investigates the current state of smart teaching in China, highlighting its progress and challenges. By summarizing the current status and challenges of smart classrooms in China through a literature review, this study proposes corresponding countermeasures. Although China has made great progress in smart teaching, challenges remain, including the need to develop teaching materials that fully leverage these technologies and to adapt curricula to effectively incorporate them. Therefore, educators require training to adopt innovative educational concepts and integrate these technologies as integral components of their teaching strategies. The study underscores the importance of further developing smart teaching to enhance classroom quality and education, emphasizing the need for continued investment in technology and teacher training to create more effective and engaging learning environments, ultimately benefiting students and empowering educators.

## Subject Areas

Smart Teaching, Digital Transformation

## Keywords

Smart Education in China, Digital Transformation

## 1. Introduction

Throughout history, the field of education has undergone two pivotal transformations. The establishment of schools marked the first significant step, serving as

the primary institution for the deliberate and structured dissemination of human culture. The second major educational shift was characterized by the rise of a modern education system that is heavily reliant on classroom-based teaching. This approach enabled the widespread implementation of compulsory education and large-scale talent cultivation, effectively meeting the demands of the industrial era (Zhao & Bao, 2014) [1]. Yuan (2023) [2] thought that with the rapid advancement of technology, a new wave of educational transformation is widely anticipated and has been termed the "third educational revolution." This shift is propelled by technological progress, with digital advancements set to reshape the way education is delivered and experienced. In the contemporary era, the field of education has seen significant reforms driven by the development of artificial intelligence and high technology, with smart teaching gaining increasing popularity. On the one hand, smart teaching offers significant convenience and flexibility, enhancing the learning experience for students. On the other hand, it places higher demands on both teachers and students, as well as the education system as a whole. Additionally, smart teaching can lead to information security issues and ethical concerns, such as the potential loss of ethical standards and the dilution of ethical concepts.

## 2. Current Status and Challenges of Smart Teaching

In China, smart teaching has gained significant popularity among students from primary school to university, offering great convenience and flexibility. Huang (2019) [3] pointed out that the "S.M.A.R.T" Classroom or Teaching represents a teaching environment that is Showing, Manageable, Accessible, Real-time Interactive, and Testing. The intelligent teaching was created based on artificial intelligence (AI), and in The Interplay of Learning, Analytics, and Artificial Intelligence in Education: A Vision for Hybrid Intelligence, which argues against the narrow conceptualization of AI as mere tools and advocates for alternative conceptualizations that achieve human-AI hybrid intelligence to improve teaching. (Mutlu Cukurova, 2024) [4] and big data, cloud computing, IoT (Internet of Things) systems (Abdellatif, I., 2019), [5] haptic elements (Minogue, J., & Jones, M. G., 2006), [6] robots (Anwar, S., Bascou, N. A., Menekse, M., & Kardgar, A. A., 2019), [7] drones (Bai, O., Chu, H., Liu, H., Hui, G., 2021), [8] 3D printing (Chen, J., Cheng, L., 2021), [9] Scratch programs (Fagerlund, J., Häkkinen, P., Vesisenaho, M., Viiri, J., 2021), [10] AI or augmented reality (Ivanko, Ivanko, Vinokur, & Kulikova, 2018; Jumani, Siddique, Laghair, Abro, & Khan, 2022). [11] [12]

However, numerous challenges remain. These include a lack of teaching materials, unfamiliarity with artificial intelligence in many remote areas, data privacy and security, and so on. Addressing these challenges requires high-quality students and teachers, as well as the involvement of all sectors of society.

### 2.1. The Difference between Smart Education and Traditional Education

The most significant difference between smart teaching and traditional teaching

lies in the integration of advanced technology, which makes the classroom more dynamic and interactive. Yu (2021) [13] held the view that smart classrooms use technology to create a dynamic, efficient learning environment that covers all stages of education, from pre-class to post-class. They collect and digitize student learning data, allowing teachers to understand and adapt to student needs with precision. Teachers can quickly access feedback, ensuring continuous improvement in teaching methods. Enhanced communication between teachers and students facilitates real-time interaction and tracking of student progress. Additionally, smart classrooms enable personalized teaching by providing diverse media resources tailored to individual students. However, traditional teaching often centers on the teacher employing a one-size-fits-all curriculum, a fixed sequence of lessons, and adherence to standardized responses. This approach, while effective in its own right, can lead to passive student learning and stifle innovation, severely restricting personalized learning and the free development of individual talents (Yuan, 2023) [2]. In traditional classes, teachers may struggle to pay attention to each student's individual development. In contrast, smart teaching leverages AI to collect and analyze the performance data of every student, enabling more personalized and effective instruction.

Moreover, smart teaching places a greater emphasis on student-centered learning, which is more beneficial for students' engagement and development. Unlike traditional classes where teachers typically use chalk and blackboards to present knowledge, smart classes can utilize a wider range of digital tools to show and establish knowledge more vividly and conveniently. This not only enhances students' understanding and retention of information but also fosters a more engaging and interactive learning environment.

What's more, Liu (2023) [14] pointed out that the role of smart classrooms in driving and facilitating the digital transformation of teaching is characterized by the following five aspects:

1) Student-Centric Approach

Smart classrooms transcend the traditional focus on knowledge dissemination. They prioritize core competencies, shifting the emphasis from subject matter instruction to fostering students' core literacy. The aim is to nurture students' wisdom and support their holistic and individual growth.

2) Data-Centricity

Data serves as the foundation for enhancing classroom teaching intelligence. Liu (2022) [15] thought that the process encompasses data collection, the transformation of information into knowledge, and the generation of intelligent insights, which are crucial for the evolution of teaching wisdom.

3) Holistic Business Transformation

Huang (2022) [16] pointed out that the digital overhaul of teaching represents a comprehensive shift in educational practices within schools. It entails the digitalization of every facet, phase, operation, and domain of education. This encompasses pre-class preparation, in-class engagement, and post-class follow-up, as well

as encouraging interdisciplinary connections to bolster students' all-around capabilities.

4) Intelligent Teaching Paradigm

Leveraging an intelligent classroom framework, this approach entails targeted instruction, tailored learning experiences, smart assessment methods, data-driven evaluations, and meticulous administration. Together, these elements forge a novel paradigm of intelligent teaching, propelling the digital and intelligent evolution of educational practices.

5) Ecosystem-Oriented Education

Smart classrooms engineer a unified intelligent learning ecosystem. This integration bridges the gap between face-to-face instruction and online learning, classroom-based teaching and out-of-class study, as well as virtual and real-world educational experiences. Powered by digital technology and data flow, this new model of intelligent teaching catalyzes the ecological progression of digital education.

In a word, the smart teaching pays more attention to students, helping students to improve themselves. It offers a more personalized, engaging, and flexible learning experience, enabling students to develop a wide range of skills and knowledge. Through the use of advanced technologies, it enhances the efficiency and effectiveness of teaching and learning, ultimately leading to better educational outcomes and a brighter future for students.

## 2.2. The Positive Effects of Smart Education

In China, an increasing number of educators at both primary and tertiary levels are embracing smart teaching methods, utilizing a variety of technological tools. Studies have consistently shown the advantages of this approach, such as increased student involvement and interaction (Morshedian *et al.*, 2023), [17] and a significant boost in academic achievement (Hu *et al.*, 2022; Meng *et al.*, 2023) [18] [19] and also highlights student digital literacy and improves comprehension and memory through the use of varied multimedia materials that accommodate different learning preferences. (McCarthy, Coughlan, & Mills, 2024) [20] Wang, Deng, and Zhang (2024) found that the intelligent English education and teaching system also has the benefits of high system capacity, strong reliability, low cost, and low energy consumption [21].

## 2.3. The Official Support for Smart Teaching

In the development process of smart classrooms, the state and educational authorities at all levels have introduced a series of policies, providing solid support for their growth.

Starting from 2012, China's government has rolled out a succession of targeted policies focused on educational informatization, which include the "Ten-Year Plan for Educational Informatization (2011-2020)" and the "Educational Informatization 2.0 Action Plan" from the Ministry of Education, as well as guidelines titled "Promoting the Construction of New Educational Infrastructures to Establish a

High-Quality Educational Support System."

In recent years, with the development of high technology, there have been more and more policies to promote the development of smart teaching. The Central Committee of the Communist Party of China and the State Council released "China Education Modernization 2035"; this guiding document emphasizes the advancement of educational informatization, positioning smart classrooms as a key component of educational informatization. Their construction and development play a crucial role in achieving educational modernization, providing strategic direction for the long-term planning and positioning of smart classrooms.

The State Council released the "New Generation Artificial Intelligence Development Plan," proposing the development of smart campuses and the integration of artificial intelligence throughout the entire process of teaching, management, and resource construction. As a core part of smart campuses, smart classrooms benefit from the in-depth integration of artificial intelligence technology, enabling more intelligent and personalized teaching experiences.

The Ministry of Education released the "Notice on Strengthening Artificial Intelligence Education in Primary and Secondary Schools," requiring the establishment of an artificial intelligence education section on the National Primary and Secondary School Smart Education Platform. This platform extensively gathers high-quality educational resources and achieves the co-construction and sharing of these resources.

Shanxi Province focuses on the field of special education. Shanxi Province encourages the full application of new technologies such as the Internet, cloud computing, big data, virtual reality, and artificial intelligence to advance the construction of smart campuses and smart classrooms in special education.

### 2.4. Achievements of Smart Teaching in China

With the implementation of these policies, the concept of smart teaching has been introduced in China's education system. And in recent years, China's ranking in the Global Digital Education Development Index has soared from 24th to 9th. Teachers at all levels are increasingly becoming familiar with smart teaching methods and are actively integrating them into their classrooms. In China, smart teaching, has already made great progress, and the achievements are as follows:

1) National Smart Education Platform: China's "National Smart Education Platform" has won the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of Information and Communication Technology in Education, the highest award in the UN system for educational informatization. The platform provides a wealth of learning resources that match the curriculum, including basic education, vocational education, and higher education content, as well as a variety of extracurricular materials, such as mental health, physical education, and the arts.

2) Integration of Digital Technology and Education: Smart classrooms utilize digital technologies, such as virtual reality, to make learning content more vivid and engaging, enhancing student interest and participation.

3) Artificial Intelligence + Education Application Cases: The Ministry of Education has announced the first batch of 18 typical application scenarios of "Artificial Intelligence + Education," involving innovative projects from multiple universities, promoting the application of artificial intelligence technology in the field of education.

4) Smart Education Practice Pathways: The "China Smart Education Development Report (2023)" presents 20 typical cases in the fields of basic education, vocational education, higher education, and special education, showcasing the practice of digital education in China, and distilling the five major practice pathways for the development of smart education in China.

Currently, China is making every effort to integrate smart teaching into educational systems at all levels. This innovative approach to education is rapidly spreading throughout the nation, reaching every corner and impacting learners from kindergarten to university. By embracing smart teaching, China is not only enhancing its domestic educational landscape but also aligning itself with the global trend of digitalization. This move signifies China's commitment to leveraging technology to improve educational quality and prepare its students for the challenges and opportunities of the digital age, thereby contributing to the overall advancement of education on a worldwide scale.

### 2.5. Challenges of Smart Teaching in China

In the digital age, the rapid evolution of technology is transforming various sectors, including education. The advent of GPT (Generative Pre-trained Transformer) exemplifies this swift progression. Prior to GPT, advanced technologies were already evolving quickly, but the emergence of GPT marked a new era for artificial intelligence (Yenduri *et al.*, 2023) [22]. This technological leap has propelled smart teaching into the mainstream, promising further rapid advancements akin to those seen with GPT and other AI innovations.

However, true teachers will have a lasting impact. As Mutlu Cukurova (2024) [4] suggests, achieving human-AI hybrid intelligence can enhance teaching. However, the nationwide implementation of smart teaching faces several obstacles. Material limitations continue to pose challenges in the implementation of smart teaching. Some schools are unable to provide smart technology for every student, exacerbating existing disparities in educational resources. Moreover, students in remote areas are often unaware of the significant global changes driven by technology, and many students and teachers have yet to encounter AI. Additionally, not every teacher is familiar with the concept of smart teaching or able to apply it flexibly. Both teachers' and students' digital literacy still needs to be enhanced to fully leverage the benefits of smart teaching. Wang, Deng, and Zhang (2024) [21] found that the intelligent English education and teaching evaluation system based on the IoTs system places high demands on teachers. Because the intelligence of the system requires users to operate carefully, some teachers with poor ability to accept new things need professional training. This process is a bit cumbersome

and may cause teachers' irritability. Secondly, students may not understand the significance of using the intelligent English education and teaching evaluation system, and cannot cooperate with teachers to complete the relevant education and teaching evaluation work, which greatly affects the evaluation effect. Therefore, it is necessary to provide teachers and students with targeted training before launching this intelligent English education and teaching evaluation system.

Besides, in the digital era, personal information is under significant threat. The transparency of personal data has increased, making it more vulnerable to misuse. Many students express concerns about their information security while using AI and other technologies. This heightened risk of data breaches and privacy violations can lead to a sense of insecurity and mistrust among students.

Moreover, the rapid advancement of technology has led to a dilution of ethical concepts in students' minds. The ease with which information can be accessed and shared online may inadvertently foster a culture where ethical considerations are overlooked. Students may not fully grasp the implications of their digital actions, such as the potential for their data to be used without consent or the spread of misinformation. This ethical ambiguity can undermine the development of responsible digital citizenship and the critical thinking skills necessary to navigate the complex digital landscape.

Furthermore, despite the prevalent view in favor of smart teaching, some critics argue that certain implementation methods have been misused and manipulated. However, these critics acknowledge that they, too, are affected by the initiative's growing popularity and prestigious status, as well as its innovative appeal (Decuypere *et al.*, 2021) [23].

## 3. The Strategies for Overcoming the Challenges of Smart Teaching

In addition to all these challenges, there are increasingly higher demands for both students and teachers than ever before. First, it is essential to enhance teacher training and capability improvement, emphasizing the need to strengthen teachers' training in smart teaching. This includes improving their information literacy, technical application skills, and innovative teaching abilities, enabling teachers to better adapt to the developmental demands of smart teaching. Second, teachers must recognize the shift in their roles, moving from traditional knowledge transmitters to learning facilitators, learning partners, and innovative educational practitioners. This transformation has significant implications and is important for teachers' professional development. Just as Lu (2021) [24] pointed out, the integration of artificial intelligence into classrooms necessitates that educators not only grasp the application of AI technologies but also actively seek out and harness their beneficial impacts within the educational context. This shift places heightened expectations on educators' proficiency with AI. In conventional teaching settings, instructors could effectively fulfill their teaching objectives through verbal communication supplemented by textbooks, blackboards, and chalk. However, in

the realm of intelligent education, a broader array of digital teaching tools has become essential for teachers.

It is an obvious phenomenon that in China, some primary education teachers do not have the desire to accept the concept of smart teaching, and they even reject it. However, in the long term, teachers must pay attention to self-improvement.

Students, as the new generation, are more likely to accept new ways. However, there are also questions they need to address. Higher demands are placed on the cultivation of students' self-learning abilities, information filtering and processing skills, innovative thinking, and practical capabilities. Additionally, there is an emphasis on how students can overcome the difficulties and challenges they may encounter during the process of smart teaching.

Smart teaching facilitates cross-disciplinary integration, enabling students to apply diverse knowledge to solve complex problems, thereby enhancing their comprehensive thinking abilities. The convergence of different subjects allows students to approach issues from multiple angles, promoting a holistic understanding and the synthesis of information across traditional academic boundaries. With the aid of artificial intelligence, virtual reality, and other advanced technologies, students gain easy access to knowledge from various subjects. Smart teaching is not merely about integrating technology into classrooms; it's about forging a dynamic, interconnected learning ecosystem where students can freely explore, innovate, and apply their knowledge across disciplines. This transformation equips students with the skills and mindset needed to succeed in an increasingly complex and interconnected world.

What's more, in smart classrooms, teachers are likely to employ Game-based Learning to engage students. Gan & He (2021) [25] pointed out that Gamified curricula are emerging as a novel approach in the realm of intelligent foreign language education. These curricula foster immersive, stress-free learning environments through gamification, adhering to the pedagogical principle of "learning by doing" while emphasizing the intrinsic values of authenticity, morality, and aesthetics within the educational process. Additionally, these courses meticulously attend to the design of the learning milieu, the cultivation of learner motivation, the curation of educational content, and the provision of supportive learning tools. The integration of gamified incentives, such as hidden treasures, rewards, and unexpected delights, ensures ongoing feedback for students, thereby augmenting their commitment and investment in the learning journey. With virtual reality and other technologies, the smart classroom will become increasingly enjoyable and relaxing. Moreover, gamified curricula emphasize a student-centered approach by directly involving students, motivating their learning interests, and improving their learning abilities.

Ultimately, smart teaching is becoming increasingly adaptive to students' needs, with a greater emphasis on personalized learning. Several studies have indicated that smart teaching can have a positive impact on students' mental health. By leveraging big data and artificial intelligence, educators can more accurately analyze students' learning behaviors and psychological states, thereby tailoring more per-

sonalized and dynamic learning paths for each student.

## 4. Conclusions

In the digital era, with the rapid advancement of high technologies such as AI, VR, and IoT, education cannot avoid the trend of digitalization. Up until now, China has gradually implemented smart teaching, integrating new technologies into the education field across basic, vocational, and higher education.

Education is the foundation of a country. The foundation of education is to nurture individuals, providing them with opportunities to realize their potential. Our country is making great efforts to improve education. Smart teaching places the student-centered approach in an essential position, paying more attention to student involvement. Students can experience more realistic classroom situations through virtual reality and other technologies, which traditional classrooms cannot achieve. While studying, AI can provide students with individualized instructions that are more direct and accurate.

However, there are still many challenges in smart teaching, indicating that there are higher demands for both students and teachers, as well as all stakeholders, because smart teaching is a new trend that requires more research and exploration. However, there is a hopeful prospect for smart teaching, and it is more adaptive to the development of our society.

## Conflicts of Interest

The author declares no conflicts of interest.

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